HO 4 Solutions

1.) the tennis ball is horizontally launched so $v_{yo} = 0$ and $a = -g = -9.8\ \frac{\text{m}}{\text{s}^2}$ also $y_o = 1.00\ \text{m}$, $y = 0$ and $\Delta x = 2.80\ \text{m}$

a.) time of flight is determined by the time the ball takes to fall 1.00 m

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = -\frac{1}{2}gt^2 + y_o \text{ so } t = \sqrt{\frac{2(y_o - y)}{g}} = \sqrt{\frac{2(1.0\ \text{m} - 0)}{\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)}} = \boxed{0.452\ \text{s}}$$

b.) $v_{yo} = 0$ so $v_o = v_x = \frac{\Delta x}{\Delta t} = \frac{2.8\ \text{m}}{0.452\ \text{s}} = \boxed{6.2\ \frac{\text{m}}{\text{s}}}$

c.) $v = \sqrt{v_x^2 + v_y^2}$ and $v_y = -gt + v_{yo} = -\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)(0.452\ \text{s}) + 0 = -4.43\ \frac{\text{m}}{\text{s}}$

therefore $v = \sqrt{\left(6.2\ \frac{\text{m}}{\text{s}}\right)^2 + \left(-4.43\ \frac{\text{m}}{\text{s}}\right)^2} = \boxed{7.62\ \frac{\text{m}}{\text{s}}}$ and $\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\frac{-4.43\ \frac{\text{m}}{\text{s}}}{6.2\ \frac{\text{m}}{\text{s}}}\right) = \boxed{-35.5°}$

2.) the book is horizontally launched so $v_{yo} = 0$, $a = -g = -9.8\ \frac{\text{m}}{\text{s}^2}$, and $v_x = v_o = 1.25\ \frac{\text{m}}{\text{s}}$

a.) $t = 0.400\ \text{s}$ and $y = 0$

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = -\frac{1}{2}gt^2 + y_o \text{ so } y_o = \frac{1}{2}gt^2 = \frac{1}{2}\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)(0.400\ \text{s})^2 = \boxed{0.784\ \text{m}}$$

b.) $\Delta x = v_x t = \left(1.25\ \frac{\text{m}}{\text{s}}\right)(0.400\ \text{s}) = \boxed{0.50\ \text{m}}$

3.) the bomb is horizontally launched so $v_{yo} = 0$, $a = -g = -9.8\ \frac{\text{m}}{\text{s}^2}$, and $v_x = v_o = 120\ \frac{\text{m}}{\text{s}}$

a.) time of flight is determined by the time the ball takes to fall 2000 m

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = -\frac{1}{2}gt^2 + y_o \text{ so } t = \sqrt{\frac{2(y_o - y)}{g}} = \sqrt{\frac{2(2000\ \text{m} - 0)}{\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)}} = \boxed{20.2\ \text{s}}$$

b.) $v_x = v_o = \boxed{120\ \frac{\text{m}}{\text{s}}}$ and $v_y = -gt + v_{yo} = -\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)(20.2\ \text{s}) + 0 = \boxed{-198\ \frac{\text{m}}{\text{s}}}$

4.) the bullet is horizontally launched so $v_{yo} = 0$, $a = -g = -9.8\ \frac{\text{m}}{\text{s}^2}$, and $v_x = v_o = 275\ \frac{\text{m}}{\text{s}}$

since $\Delta x = 75\ \text{m}$ and $\Delta x = v_x t$ the time of flight is $t = \frac{\Delta x}{v_x} = \frac{75\ \text{m}}{275\ \frac{\text{m}}{\text{s}}} = 0.273\ \text{s}$

$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}gt^2 = -\frac{1}{2}\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)(0.273\ \text{s})^2 = -0.365\ \text{m}$ so the bullet falls $\boxed{0.365\ \text{m}}$

5.) $v_{yo} = 15.0\ \frac{\text{m}}{\text{s}}$, $v_x = 25.0\ \frac{\text{m}}{\text{s}}$, and $a = -g = -9.8\frac{\text{m}}{\text{s}^2}$

a.) maximum height occurs when $v_y = 0$

$$v_y = -gt + v_{yo} \text{ so } t = \frac{v_{yo} - v_y}{g} = \frac{\left(15.0\ \frac{\text{m}}{\text{s}} - 0\right)}{\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)} = \boxed{1.53\text{ s}}$$

b.) assuming $y_o = 0$

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = -\frac{1}{2}\left(9.8\frac{\text{m}}{\text{s}^2}\right)(1.53\text{ s})^2 + \left(15.0\ \frac{\text{m}}{\text{s}}\right)(1.53\text{ s}) + 0 = \boxed{11.5\text{ m}}$$

c.) $\Delta x = v_x t$ and since the trajectory is symmetric the total time is twice that to reach the maximum height

$$\Delta x = v_x t = \left(25.0\ \frac{\text{m}}{\text{s}}\right)(3.06\text{ s}) = \boxed{76.5\text{ m}}$$

6.) $y_o = 30.0\text{ m}$, $a = -g = -9.8\frac{\text{m}}{\text{s}^2}$, $v_o = 40.0\ \frac{\text{m}}{\text{s}}$, and $\theta = 33.0°$

$$v_x = v_o\cos\theta = \left(40.0\ \frac{\text{m}}{\text{s}}\right)\cos(33.0°) = 33.55\ \frac{\text{m}}{\text{s}} \text{ and } v_{yo} = v_o\sin\theta = \left(40.0\ \frac{\text{m}}{\text{s}}\right)\sin(33.0°) = 21.79\ \frac{\text{m}}{\text{s}}$$

a.) maximum height occurs when $v_y = 0$

$$v_y = -gt + v_{yo} \text{ so } t = \frac{v_{yo} - v_y}{g} = \frac{\left(21.79\ \frac{\text{m}}{\text{s}} - 0\right)}{\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)} = 2.22\text{ s}$$

$$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}\left(9.8\frac{\text{m}}{\text{s}^2}\right)(2.22\text{ s})^2 + \left(21.79\ \frac{\text{m}}{\text{s}}\right)(2.22\text{ s}) = \boxed{24.2\text{ m}}$$

alternatively without finding the time

$$v_y^2 = v_{yo}^2 + 2a\Delta y \Rightarrow 0 = v_{yo}^2 - 2g\Delta y \text{ and } \Delta y = \frac{v_{yo}^2}{2g} = \frac{\left(21.79\ \frac{\text{m}}{\text{s}}\right)^2}{2\left(\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)\right)} = \boxed{24.2\text{ m}}$$

b.) find the time it takes the rock to reach the ground where $y = 0$

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = 0 = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2 + \left(21.79\ \frac{\text{m}}{\text{s}}\right)t + 30.0\text{ m}$$

Using quadratic formula $t = 5.55$ s

The horizontal distance covered is $\Delta x = v_x t = \left(33.55\ \frac{\text{m}}{\text{s}}\right)(5.55\text{ s}) = \boxed{186.2\text{ m}}$

HO 4 Solutions

7.) $v_o = 14.0\ \frac{m}{s}$, $\theta = 49°$, $a = -g = -9.8\frac{m}{s^2}$, and $t = 2.40$ s

a.) at the beginning of the trajectory

$$v_x = v_o\cos\theta = \left(14.0\ \frac{m}{s}\right)\cos(49°) = \boxed{9.18\ \frac{m}{s}} \text{ and } v_{yo} = v_o\sin\theta = \left(14.0\ \frac{m}{s}\right)\sin(49°) = \boxed{10.57\ \frac{m}{s}}$$

at the end of the trajectory

$$v_x = \boxed{9.18\ \frac{m}{s}} \text{ and } v_y = -gt + v_{yo} = -\left(9.8\frac{m}{s^2}\right)(2.40\text{ s}) + 10.57\ \frac{m}{s} = \boxed{-12.95\ \frac{m}{s}}$$

b.) horizontal distance is $\Delta x = v_x t = \left(9.18\ \frac{m}{s}\right)(2.40\text{ s}) = \boxed{22.0\text{ m}}$

c.) initial height y_o

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = 0$$

$$\text{so } y_o = \frac{1}{2}gt^2 - v_{yo}t = \frac{1}{2}\left(9.8\frac{m}{s^2}\right)(2.40\text{ s})^2 - \left(10.57\ \frac{m}{s}\right)(2.40\text{ s}) = \boxed{2.86\text{ m}}$$

HO 5 Solutions

1.) for the egg: $a = -g = -9.8\frac{m}{s^2}$, $v_{eo} = 12.0\ \frac{m}{s}$, $\theta_e = 50.0°$

$$v_{ex} = v_{eo}\cos\theta_e = \left(12.0\ \frac{m}{s}\right)\cos(50.0°) = 7.71\ \frac{m}{s} \text{ and } v_{eyo} = v_{eo}\sin\theta_e = \left(12.0\ \frac{m}{s}\right)\sin(50.0°) = 9.19\ \frac{m}{s}$$

for the car: $a = 0$, $v_c = 8.0\ \frac{m}{s}$

Assuming that the egg hits at the same height at which it was thrown the time the egg is in the air is found when

$$\Delta y = 0 = -\frac{1}{2}gt^2 + v_{eyo}t \text{ and } t = \frac{2v_{eyo}}{g} = \frac{2\left(9.19\ \frac{m}{s}\right)}{\left(9.8\frac{m}{s^2}\right)} = 1.88\text{ s}$$

The horizontal distance traveled by the egg is $\Delta x_e = v_{ex}t = \left(7.71\ \frac{m}{s}\right)(1.88\text{ s}) = 14.5$ m

The horizontal distance traveled by the car is $\Delta x_c = v_c t = \left(8.00\ \frac{m}{s}\right)(1.88\text{ s}) = 15.0$ m

The maximum distance between the student and the car is $\Delta x_e + \Delta x_c = 14.5\text{ m} + 15.0\text{ m} = \boxed{29.5\text{ m}}$

2.) $y_o = 15.0\text{ m}$, $y = 0$, $a = -g = -9.8\frac{\text{m}}{\text{s}^2}$, $\Delta x = 40.0\text{ m}$, and $\theta = 53.0°$

$$\Delta x = v_x t = (v_o\cos\theta)t \text{ so } t = \frac{\Delta x}{(v_o\cos\theta)}$$

$$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}gt^2 + (v_o\sin\theta)t = -\frac{1}{2}g\left(\frac{\Delta x}{(v_o\cos\theta)}\right)^2 + (v_o\sin\theta)\frac{\Delta x}{(v_o\cos\theta)}$$

$$\Delta y = -\frac{1}{2}g\left(\frac{\Delta x^2}{(v_o^2\cos^2\theta)}\right) + \Delta x\tan\theta$$

$$\frac{2(\Delta x\tan\theta - \Delta y)\cos^2\theta}{g\Delta x^2} = \frac{1}{v_o^2}$$

therefore $v_o = \sqrt{\frac{g\Delta x^2}{2(\Delta x\tan\theta - \Delta y)\cos^2\theta}} = \sqrt{\frac{\left(9.8\frac{\text{m}}{\text{s}^2}\right)(40.0\text{ m})^2}{2((40.0\text{ m})\tan 53.0° - (0 - 15\text{ m}))\cos^2 53.0°}} = \boxed{17.8\ \frac{\text{m}}{\text{s}}}$

3.) $y_o = 0$, $a = -g = -9.8\frac{\text{m}}{\text{s}^2}$, $v_o = 40.0\ \frac{\text{m}}{\text{s}}$, and $\theta = 53.1°$

$$v_x = v_o\cos\theta = \left(40.0\ \frac{\text{m}}{\text{s}}\right)\cos(53.1°) = 24\ \frac{\text{m}}{\text{s}} \text{ and } v_{yo} = v_o\sin\theta = \left(40.0\ \frac{\text{m}}{\text{s}}\right)\sin(53.1°) = 32\ \frac{\text{m}}{\text{s}}$$

a.) times when $y = 25.0\text{ m}$

$$y = -\frac{1}{2}gt^2 + v_{yo}t + y_o = 25.0\text{ m} = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2 + \left(32\ \frac{\text{m}}{\text{s}}\right)t + 0$$

so $0 = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2 + \left(32\ \frac{\text{m}}{\text{s}}\right)t - 25.0\text{ m}$

using quadratic formula $\boxed{t = 0.91\text{ s}}$ and $\boxed{t = 5.62\text{ s}}$

b.) for both times the horizontal component is $v_x = \boxed{24\ \frac{\text{m}}{\text{s}}}$

the vertical component is found using $v_y = -gt + v_{yo}$

$$v_y(0.91\text{ s}) = -\left(9.8\frac{\text{m}}{\text{s}^2}\right)(0.91\text{ s}) + 32\ \frac{\text{m}}{\text{s}} = \boxed{23.1\ \frac{\text{m}}{\text{s}}}$$

$$v_y(5.62\text{ s}) = -\left(9.8\frac{\text{m}}{\text{s}^2}\right)(5.62\text{ s}) + 32\ \frac{\text{m}}{\text{s}} = \boxed{-23.1\ \frac{\text{m}}{\text{s}}}$$

c.) the time when returns to the same level at which it was thrown is when $y = y_o$ or $\Delta y = 0$

$$\Delta y = 0 = -\frac{1}{2}gt^2 + v_{yo}t \text{ and } t = \frac{2v_{yo}}{g} = \frac{2\left(32\ \frac{\text{m}}{\text{s}}\right)}{\left(9.8\frac{\text{m}}{\text{s}^2}\right)} = 6.53\text{ s}$$

the horizontal component is still $v_x = 24\ \frac{\text{m}}{\text{s}}$

the vertical component is found using $v_y = -gt + v_{yo}$

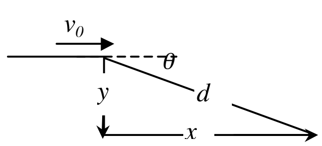
$$v_y(6.53\text{ s}) = -\left(9.8\frac{\text{m}}{\text{s}^2}\right)(6.53\text{ s}) + 32\ \frac{\text{m}}{\text{s}} = -32\ \frac{\text{m}}{\text{s}}$$

so the magnitude is $v(6.53\text{ s}) = \sqrt{v_x^2 + v_y^2} = \sqrt{\left(24\ \frac{\text{m}}{\text{s}}\right)^2 + \left(-32\ \frac{\text{m}}{\text{s}}\right)^2} = \boxed{40.0\ \frac{\text{m}}{\text{s}}}$

the direction is $\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\frac{-32\ \frac{\text{m}}{\text{s}}}{24\ \frac{\text{m}}{\text{s}}}\right) = \boxed{-53.1°}$

So it returns at the same speed but moving in the downward direction.

4.)



$$a = -g = -9.8\frac{\text{m}}{\text{s}^2},\ v_o = 25.0\ \frac{\text{m}}{\text{s}},\ \theta = 35.0°$$

horizontally launched so $v_x = 25.0\ \frac{\text{m}}{\text{s}}$ and $v_{yo} = 0$

a.) the horizontal displacement is given by $\Delta x = v_x t = \left(25\ \frac{\text{m}}{\text{s}}\right)t$

the vertical displacement is given by $\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2$

$$\text{therefore } \frac{\Delta y}{\Delta x} = \frac{-\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2}{\left(25\ \frac{\text{m}}{\text{s}}\right)t} = -\left(0.196\text{ s}^{-1}\right)t$$

from the geometry of the situation $\frac{\Delta y}{\Delta x} = \tan(-35.0°)$ so $t = \frac{\tan(-35.0°)}{-\left(0.196\text{ s}^{-1}\right)} = 3.57\text{ s}$

therefore $\Delta x = \left(25\ \frac{\text{m}}{\text{s}}\right)(3.57\text{ s}) = 89.3\text{ m}$ and $\Delta y = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)(3.57\text{ s})^2 = -62.5\text{ m}$

the coordinate is therefore $(x, y) = \boxed{(89.3\text{ m},\ -62.5\text{ m})}$

b.) the vertical component is $v_y = -gt + v_{yo} = -gt = -\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)(3.57\ \text{s}) = \boxed{-35.0\ \frac{\text{m}}{\text{s}}}$

5.) $a = -g = -9.8\frac{\text{m}}{\text{s}^2},\ v_o = 8.00\ \frac{\text{m}}{\text{s}},\ \theta = -20.0°$ when $y = 0,\ t = 3.00$ s

$$v_x = v_o\cos\theta = \left(8.00\ \frac{\text{m}}{\text{s}}\right)\cos(-20.0°) = 7.52\ \frac{\text{m}}{\text{s}} \text{ and } v_{yo} = v_o\sin\theta = \left(8.00\ \frac{\text{m}}{\text{s}}\right)\sin(-20.0°) = -2.74\ \frac{\text{m}}{\text{s}}$$

a.) the horizontal displacement is $\Delta x = v_x t = \left(7.52\ \frac{\text{m}}{\text{s}}\right)(3.00\ \text{s}) = \boxed{22.6\ \text{m}}$

b.) the initial height is obtained from $y = -\frac{1}{2}gt^2 + v_{yo}t + y_o \Rightarrow y_o = \frac{1}{2}gt^2 - v_{yo}t + y$

$$y_o = \frac{1}{2}\left(9.8\frac{\text{m}}{\text{s}^2}\right)(3.00\ \text{s})^2 - \left(-2.74\ \frac{\text{m}}{\text{s}}\right)(3.00\ \text{s}) + 0 = \boxed{52.3\ \text{m}}$$

c.) time when $y = 42.3$ m $\quad y = -\frac{1}{2}gt^2 + v_{yo}t + y_o$ so $42.3\ \text{m} = -\frac{1}{2}\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)t^2 + \left(-2.74\ \frac{\text{m}}{\text{s}}\right)t + 52.3\ \text{m}$

$$0 = -\left(4.9\ \frac{\text{m}}{\text{s}^2}\right)t^2 + \left(-2.74\ \frac{\text{m}}{\text{s}}\right)t + 10\ \text{m} \text{ and using quadratic formula } t = \boxed{1.18\ \text{s}}$$

6.) $$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}gt^2 + (v_o\sin\theta)t = 0 \text{ so } t = \frac{2v_o\sin\theta}{g}$$

the range is therefore $R = \Delta x = v_x t = (v_o\cos\theta)\left(\frac{2v_o\sin\theta}{g}\right) = \frac{2v_o^2\sin\theta\cos\theta}{g}$

using the identity $\sin 2\theta = 2\sin\theta\cos\theta$, $R = \frac{v_o^2\sin 2\theta}{g}$

alternatively the time could be found be doubling the time to reach the maximum height

maximum height occurs when $v_y = 0$ so $v_y = -gt + v_{yo} = 0 \Rightarrow t_{1/2} = \frac{v_{yo}}{g} = \frac{v_o\sin\theta}{g}$

7.) maximum height occurs when $v_y = 0$ so $v_y = -gt + v_{yo} = 0 \Rightarrow t = \frac{v_{yo}}{g} = \frac{v_o\sin\theta}{g}$

$$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}gt^2 + (v_o\sin\theta)t$$

$$\Delta y = -\frac{1}{2}g\left(\frac{v_o\sin\theta}{g}\right)^2 + (v_o\sin\theta)\left(\frac{v_o\sin\theta}{g}\right)$$

$$\Delta y = -\frac{1}{2}g\left(\frac{v_o^2\sin^2\theta}{g^2}\right) + \left(\frac{v_o^2\sin^2\theta}{g}\right) = -\frac{1}{2}\left(\frac{v_o^2\sin^2\theta}{g}\right) + \left(\frac{v_o^2\sin^2\theta}{g}\right)$$

$$\Delta y = \frac{v_o^2\sin^2\theta}{2g} = y - y_o \text{ so } y_{max} = \frac{v_o^2\sin^2\theta}{2g} + y_o$$

HO 6 Solutions

1.) $r = 1.00\text{ m}$ and $v = 20.0\ \frac{\text{m}}{\text{s}}$

$$a_r = \frac{v^2}{r} = \frac{\left(20.0\ \frac{\text{m}}{\text{s}}\right)^2}{1.00\text{ m}} = \boxed{400\ \frac{\text{m}}{\text{s}^2}}$$

2.) $r = 6.38 \text{ x } 10^6\text{ m}$ and $T = 24\text{ hr}\left(\frac{3600\text{ s}}{1\text{ hr}}\right) = 8.64 \text{ x } 10^4\text{ s}$

a.) $$v = \frac{2\pi r}{T} = \frac{2\pi\left(6.38 \text{ x } 10^6\text{ m}\right)}{8.64 \text{ x } 10^4\text{ s}} = 464\ \frac{\text{m}}{\text{s}} \text{ and } a_r = \frac{v^2}{r} = \frac{\left(464\ \frac{\text{m}}{\text{s}}\right)^2}{6.38 \text{ x } 10^6\text{ m}} = \boxed{0.034\ \frac{\text{m}}{\text{s}^2}}$$

b.) $a_r = 9.8\ \frac{\text{m}}{\text{s}^2}$ $$a_r = \frac{v^2}{r} \Rightarrow v = \sqrt{a_r r} = \sqrt{\left(9.8\ \frac{\text{m}}{\text{s}^2}\right)\left(6.38 \text{ x } 10^6\text{ m}\right)} = 7.91 \text{ x } 10^3\ \frac{\text{m}}{\text{s}}$$

$$v = \frac{2\pi r}{T} \Rightarrow T = \frac{2\pi r}{v} = \frac{2\pi\left(6.38 \text{ x } 10^6\text{ m}\right)}{\left(7.91 \text{ x } 10^3\ \frac{\text{m}}{\text{s}}\right)} = 5068\text{ s so } T = 5068\text{ s}\left(\frac{1\text{ hr}}{3600\text{ s}}\right) = \boxed{1.41\text{ hr}}$$

3.) After string breaks the rock is a horizontally launched projectile with $\Delta y = -1.2\text{ m}$, $\Delta x = 2.0\text{ m}$, and $a = -g = -9.8\frac{\text{m}}{\text{s}^2}$

$r = 0.30\text{ m}$

$$\Delta y = -\frac{1}{2}gt^2 + v_{yo}t = -\frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2\Delta y}{-g}} = \sqrt{\frac{2(-1.2\text{ m})}{\left(-9.8\frac{\text{m}}{\text{s}^2}\right)}} = 0.495\text{ s}$$

$$v_x = \frac{\Delta x}{\Delta t} = \frac{2.0\text{ m}}{0.495\text{ s}} = 4.04\ \frac{\text{m}}{\text{s}} \text{ and } a_r = \frac{v^2}{r} = \frac{\left(4.04\ \frac{\text{m}}{\text{s}}\right)^2}{0.30\text{ m}} = \boxed{54.4\ \frac{\text{m}}{\text{s}^2}}$$

4.) $r = 1.50 \text{ x } 10^{11}\text{ m}$ and $T = 365\text{ days} \Rightarrow T = 365\text{ days}\left(\frac{24\text{ hr}}{1\text{ day}}\right)\left(\frac{3600\text{ s}}{1\text{ hr}}\right) = 3.154 \text{ x } 10^7\text{ s}$

a.) $$v = \frac{2\pi r}{T} = \frac{2\pi\left(1.50 \text{ x } 10^{11}\text{ m}\right)}{3.154 \text{ x } 10^7\text{ s}} = \boxed{3.0 \text{ x } 10^4\ \frac{\text{m}}{\text{s}}}$$

b.) $$a_r = \frac{v^2}{r} = \frac{\left(3.0 \text{ x } 10^4\ \frac{\text{m}}{\text{s}}\right)^2}{1.50 \text{ x } 10^{11}\text{ m}} = \boxed{0.0060\ \frac{\text{m}}{\text{s}^2}}$$

5.) $r = 0.20\text{ m}$, $v_o = 0$, $v = 0.700\ \frac{\text{m}}{\text{s}}$, and $t = 1.75\text{ s}$

a.) Assuming uniform acceleration $a_t = \frac{\Delta v}{\Delta t} = \frac{v - v_o}{t - t_o} = \frac{\left(0.70\ \frac{\text{m}}{\text{s}} - 0\right)}{(1.75\text{ s} - 0)} = \boxed{0.40\ \frac{\text{m}}{\text{s}^2}}$

b.) $v = at + v_o = \left(0.40\ \frac{\text{m}}{\text{s}^2}\right)(1.25\text{ s}) + 0 = 0.50\ \frac{\text{m}}{\text{s}}$ and $a_r = \frac{v^2}{r} = \frac{\left(0.50\ \frac{\text{m}}{\text{s}}\right)^2}{0.20\text{ m}} = \boxed{1.25\ \frac{\text{m}}{\text{s}^2}}$

c.) $a = \sqrt{a_r^2 + a_t^2} = \sqrt{\left(1.25\ \frac{\text{m}}{\text{s}^2}\right)^2 + \left(0.40\ \frac{\text{m}}{\text{s}^2}\right)^2} = \boxed{1.31\ \frac{\text{m}}{\text{s}^2}}$

6.) $v_o = 25\ \frac{\text{m}}{\text{s}}$, $v = 14.0\ \frac{\text{m}}{\text{s}}$, $t = 15.0\text{ s}$, and $r = 150\text{ m}$

Assuming uniform acceleration $a_t = \frac{\Delta v}{\Delta t} = \frac{v - v_o}{t - t_o} = \frac{\left(14\ \frac{\text{m}}{\text{s}} - 25\ \frac{\text{m}}{\text{s}}\right)}{(15\text{ s} - 0)} = -0.733\ \frac{\text{m}}{\text{s}^2}$

when $v = 14.0\ \frac{\text{m}}{\text{s}}$ $\quad a_r = \frac{v^2}{r} = \frac{\left(14.0\ \frac{\text{m}}{\text{s}}\right)^2}{150\text{ m}} = 1.31\ \frac{\text{m}}{\text{s}^2}$

$$a = \sqrt{a_r^2 + a_t^2} = \sqrt{\left(1.31\ \frac{\text{m}}{\text{s}^2}\right)^2 + \left(-0.733\ \frac{\text{m}}{\text{s}^2}\right)^2} = \boxed{1.50\ \frac{\text{m}}{\text{s}^2}}$$

7.) $x = R\cos\omega t$ and $y = R\sin\omega t$

a.) $$d = \sqrt{x^2 + y^2} = \sqrt{(R\cos\omega t)^2 + (R\sin\omega t)^2} = \sqrt{\left(R^2\cos^2\omega t\right) + \left(R^2\sin^2\omega t\right)}$$

$$d = \sqrt{R^2\left(\cos^2\omega t + \sin^2\omega t\right)} = \sqrt{R^2(1)} = \boxed{R}$$

b.) $v_x = \frac{dx}{dt} = \frac{d}{dt}(R\cos\omega t) = -\omega R\sin\omega t$ and $v_y = \frac{dy}{dt} = \frac{d}{dt}(R\sin\omega t) = \omega R\cos\omega t$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(-\omega R\sin\omega t)^2 + (\omega R\cos\omega t)^2} = \sqrt{\left(\omega^2R^2\sin^2\omega t\right) + \left(\omega^2R^2\cos^2\omega t\right)}$$

$$v = \sqrt{\omega^2R^2\left(\sin^2\omega t + \cos^2\omega t\right)} = \sqrt{\omega^2R^2(1)} = \boxed{\omega R}$$

c.) $a_x = \frac{dv_x}{dt} = \frac{d}{dt}(-\omega R\sin\omega t) = -\omega^2R\cos\omega t$ and $a_y = \frac{dv_y}{dt} = \frac{d}{dt}(\omega R\cos\omega t) = -\omega^2R\sin\omega t$

$$a = \sqrt{a_x^2 + a_y^2} = \sqrt{\left(-\omega^2R\cos\omega t\right)^2 + \left(-\omega^2R\sin\omega t\right)^2} = \sqrt{\left(\omega^4R^2\cos^2\omega t\right) + \left(\omega^4R^2\sin^2\omega t\right)}$$

$$a = \sqrt{\omega^4R^2\left(\cos^2\omega t + \sin^2\omega t\right)} = \sqrt{\omega^4R^2(1)} = \boxed{\omega^2R}$$

d.) $a = \omega^2R = \omega^2R\frac{R}{R} = \frac{\omega^2R^2}{R} = \frac{(\omega R)^2}{R} = \boxed{\frac{v^2}{R}}$

8.) $r = 0.20\text{ m}$ and $v = \alpha t^2 - \beta t$ where $\alpha = 3.0\ \frac{\text{m}}{\text{s}^3}$ and $\beta = 2.0\ \frac{\text{m}}{\text{s}^2}$

a.) tangential acceleration

$$a_t = \frac{dv}{dt} = \frac{d}{dt}\left(\alpha t^2 - \beta t\right) = 2\alpha t - \beta = 2\left(3.0\ \frac{\text{m}}{\text{s}^3}\right)t - 2.0\ \frac{\text{m}}{\text{s}^2} = \left(6.0\ \frac{\text{m}}{\text{s}^3}\right)t - 2.0\ \frac{\text{m}}{\text{s}^2}$$

so at $t = 1.0\text{ s}$, $a_t = \left(6.0\ \frac{\text{m}}{\text{s}^3}\right)(1.0\text{ s}) - 2.0\ \frac{\text{m}}{\text{s}^2} = \boxed{4.0\ \frac{\text{m}}{\text{s}^2}}$

b.) centripetal acceleration

$$v = \alpha t^2 - \beta t = \left(3.0\ \frac{\text{m}}{\text{s}^3}\right)t^2 - \left(2.0\ \frac{\text{m}}{\text{s}^2}\right)t$$

so at $t = 1.0\text{ s}$, $v(1.0\text{ s}) = \left(3.0\ \frac{\text{m}}{\text{s}^3}\right)(1.0\text{ s})^2 - \left(2.0\ \frac{\text{m}}{\text{s}^2}\right)(1.0\text{ s}) = 1.0\ \frac{\text{m}}{\text{s}}$

$$a_r = \frac{v^2}{r} = \frac{\left(1.0\ \frac{\text{m}}{\text{s}}\right)^2}{0.20\text{ m}} = \boxed{5.0\ \frac{\text{m}}{\text{s}^2}}$$

c.) total acceleration

$$a = \sqrt{a_r^2 + a_t^2} = \sqrt{\left(5.0\ \frac{\text{m}}{\text{s}^2}\right)^2 + \left(4.0\ \frac{\text{m}}{\text{s}^2}\right)^2} = \boxed{6.4\ \frac{\text{m}}{\text{s}^2}}$$